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OKLAHOMA GEOLOGY NOTES

CHARLES ELIJAH DECKER

OKLAHOMA GEOLOGICAL SURVEY • THE UNIVERSITY OF OKLAHOMA • NORMAN, OKLAHOMA

Cover Picture

Charles Elijah Decker

Charles E. Decker was born near Dixon, Illinois, September 27, 1868. Educated at Northwestern University and the University of Chicago, he held teaching positions at Northwestern and at Allegheny College before coming to The University of Oklahoma as instructor in geology in 1916. He was assistant professor, 1917-1919; associate professor, 1919-1925; professor, 1925-1930; professor and head of the paleontology department, 1930-1943; and research professor emeritus from 1944 until his death in 1958. During these years at The University of Oklahoma he became an internationally recognized paleontologist and outstanding authority on graptolites.

His bibliography contains 98 papers, devoted largely to the geology of the Arbuckle Mountains region in Oklahoma and to graptolites. Some of his major contributions are: *Studies in Minor Folds* (1920); *Physical Characteristics of Arbuckle Limestone* (1928); *Simpson Group of Arbuckle and Wichita Mountains* (1930); *Stratigraphy and Physical Characteristics of Simpson Group* (1931); *Viola Limestone, Primarily of Arbuckle and Wichita Mountain Regions* (1933); *Graptolites of Sylvan Shale of Oklahoma and Polk Creek Shale of Arkansas* (1935); *Two Lower Paleozoic Groups, Arbuckle and Wichita Mountains, Oklahoma* (1939); *Stratigraphic Significance of Graptolites of Athens Shale* (1952); and *Upper Cambrian Graptolites from Virginia and Tennessee* (1958).

Throughout his professional career, Decker was active in geological and scientific organizations. He held honorary membership in American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, was a fellow in Geological Society of America, member of The Paleontological Society, American Association for the Advancement of Science, Phi Beta Kappa, and Sigma Xi. He was faculty sponsor for Sigma Gamma Epsilon from 1916 to 1951 and in 1953 became "Honorary Lifetime Sponsor." He also held national offices in American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Sigma Gamma Epsilon.

During the depression years when the Oklahoma Geological Survey was closed, Dr. Decker was named custodian of the Geological Survey, and during that time he made a careful inventory of all of the Survey publications and continued his work on the rocks and fossils of Oklahoma.

—G. G. H.

Statistics of Oklahoma's Petroleum Industry, 1964

Louise Jordan

In Oklahoma 62 new areas of hydrocarbon production were discovered and 148 wells found either a new productive zone or an outpost in a previously discovered field in 1964. The ratio of success in exploratory drilling for the year is 34.1 percent, more than double the national average of 16.68 percent. Also of significance to discovery of new production is that wells on the average are being drilled deeper and therefore are more costly. The average depth of exploratory tests has been increasing yearly since 1959, and in 1964 it jumped to 5,571 feet, 740 feet deeper than that of the previous year. If new-field wildcats (that is, tests which explore a new area) are considered, the increase in depth is even greater, averaging 5,544 feet in 1963 and 7,447 feet in 1964.

Discoveries in the State were made in every Paleozoic System, except perhaps the Cambrian, and in Lower Cretaceous rocks. Most of the new fields and pools produce from Mississippian reservoirs and are concentrated on the northeastern shelf of the Anadarko basin (Garfield, Kingfisher, Logan, and Major Counties, and southern portions of Alfalfa and Grant Counties). More than 50 percent of the discoveries were made in this area. In the Arkoma basin of Oklahoma fourteen discoveries added to the natural-gas reserves, primarily in Pennsylvanian rocks. However, one discovery well (Humble Oil & Refining Company 1 Bledsoe, sec. 9, T. 8 N., R. 23 E., Le Flore County) was dually completed in Simpson (Ordovician) and Hunton (Silurian) rocks with a potential of more than 40 million cubic feet of gas per day. As this discovery revealed the first significant Silurian reserves, as well as the first commercial Simpson production in this area of eastern Oklahoma, it has stimulated increased leasing of land.

The petroleum industry in Oklahoma discovered less new reserves of crude oil in 1964 but improved the situation in natural-gas and natural-gas-liquid reserves. Estimated proven reserves in crude oil decreased 42,253,000 barrels. Reserves of crude oil in Oklahoma have been decreasing annually for at least the last ten years (table I). Estimated proven natural-gas reserves, on the other hand, have been steadily increasing in the same period (table II). Those of natural-gas liquids have remained essentially the same (table I). Among the states, Oklahoma in 1964 ranked third after Texas and Louisiana in natural-gas reserves and fourth in crude-oil and natural-gas-liquid reserves.

The number of exploratory tests (615) drilled in 1964 in Oklahoma continued to decrease from the high of 1,196 in 1958 (table III), whereas development tests (exclusive of the Panhandle) increased from 2,716 in 1963 to 3,022 in 1964, the first substantial increase in the ten-year period 1955-1964 (table IV), also indicated by the *Oil and Gas Journal* figures (column 6) for all of Oklahoma, which include service wells. Drilling activity in Oklahoma in 1964 showing number of completions, footage, and average footage, is recorded in table V, and hydrocarbon production statistics are given in table VI.

Table VIII gives the marketed production and value of hydrocarbon production in Oklahoma for the years 1955-1964, and the cumulative totals for all years for crude oil, natural gas, natural gasoline and cycle products, and liquefied petroleum gas. In it the figures for 1955-1957 are revised from those published by the Oklahoma Geological Survey in 1958. The total value of all hydrocarbons over the 73-year period is $20.6 billion.

In 1959, the federal government completed a plant near Keyes, Oklahoma, to recover helium from natural gas. Table VII lists the amount recovered and value for the nearly six-year period of operation. Since 1961, the amount recovered has decreased. In November 1961, a rise in price of helium caused the increase in value in the following years.

The Oklahoma Geological Survey has a continuing interest in obtaining basement-rock samples and in collecting sufficient samples of Arbuckle rocks in basement tests for insoluble-residue and other studies. Table IX is a list of the basement tests drilled in Oklahoma during 1964. Of the 28 basement tests drilled, samples from only 12 have been located. Sample sets from three of the holes are available only at the Survey. Of the 14 holes drilled in northeastern Oklahoma, the area of greatest current interest, samples for only four were located and only one of these holes was surveyed by electric log. It is regrettable that such basic information is not being obtained and that few samples are being saved. The Oklahoma Geological Survey will accept basement-test samples if they are sent collect to its office at Norman. The samples should be in cloth sacks. If the donor so wishes, the samples and the information derived therefrom will be kept confidential for as long as a year.

(Tables I-IX appear on pages 153-159)

TABLE I.—ESTIMATED PROVED RESERVES, PRODUCTION, AND CHANGE IN RESERVES, 1955-1964*

END OF	CRUDE OIL RESERVES (1,000 BBLS)	CRUDE OIL PRODUCTION (1,000 BBLS)	CRUDE OIL CHANGE (MM BBLS)	NATURAL-GAS LIQUIDS RESERVES (1,000 BBLS)	NATURAL-GAS LIQUIDS PRODUCTION (1,000 BBLS)	NATURAL-GAS LIQUIDS CHANGE (MM BBLS)
1955	2,016,045	200,799	+ 61	354,354	29,365	+20
1956	2,009,798	211,811	6	355,588	30,860	+ 1
1957	1,941,521	211,447	— 68	342,643	34,097	—13
1958	1,898,128	198,519	— 43	357,507	29,585	+15
1959	1,864,749	193,446	— 33	367,569	28,319	+10
1960	1,790,500	189,654	— 74	338,313	28,483	—29
1961	1,787,429	187,845	— 3	329,180	26,849	— 9
1962	1,728,268	196,245	— 59	347,003	22,374	+18
1963	1,628,138	194,497	100	328,193	25,772	- 18
1964	1,585,885	198,879	42	342,902	29,047	+15

* American Petroleum Institute, annual report.

TABLE II.—ESTIMATED PROVED RESERVES OF NATURAL GAS IN OKLAHOMA, 1955-1964*

END OF	RESERVES (MMCF)	PRODUCTION (MMCF)	CHANGE (TRILLIONS)
1955	13,204,739	878,698	+0.9
1956	13,755,049	916,602	+0.57
1957	14,259,480	944,569	+0.50
1958	15,206,769	903,297	+0.95
1959	16,651,292	956,096	+1.44
1960	17,311,402	993,975	+0.66
1961	17,350,924	1,016,485	+0.04
1962	18,259,036**	1,035,470	+0.90**
1963	19,138,820	1,128,132	+0.78
1964	19,757,235	1,207,628	+0.62

* American Gas Association, annual report. One trillion equals 10^{12}.
** Revised in 1963.

TABLE III.—EXPLORATORY PRODUCERS (OIL, GAS, AND CONDENSATE) AND DRY HOLES DRILLED IN OKLAHOMA, 1955-1964*

YEAR	NO. OF PRODUCERS	NO. OF DRY HOLES	TOTAL TESTS	FOOTAGE	AVERAGE DEPTH (FEET)
1955	205	718	923	3,934,360	4,263
1956	266	863	1,129	4,827,949	4,276
1957	200	823	1,023	4,305,680	4,209
1958	282	914	1,196	4,670,946	3,905
1959	238	843	1,081	4,442,912	3,110
1960	260	674	934	4,210,821	4,508
1961	250	616	866	3,978,322	4,594
1962	257	546	803	3,747,798	4,667
1963	248	468	716	3,459,315	4,831
1964	210	405	615	3,426,235	5,571

* Lahee, F. H., 1962, Statistics of exploratory drilling in the United States, 1945-1960; and American Association of Petroleum Geologists, annual June issues.

TABLE IV.—DEVELOPMENT WELLS DRILLED IN OKLAHOMA, 1955-1964

YEAR	OKLAHOMA EXCLUSIVE OF PANHANDLE[1]					ALL OKLAHOMA[2]
	OIL	GAS	DRY	TOTAL	PERCENT SUCCESSFUL	TOTAL
1955	4,501	230	1,873	6,604	71.8	7,579
1956	4,380	208	1,972	6,560	70.0	7,189
1957	3,373	96	1,654	5,123	67.7	5,488
1958	3,185	218	1,603	5,006	67.9	5,500
1959	2,561	185	1,354	4,100	66.9	4,532
1960	1,539	251	570	2,360	75.8	4,102
1961	1,880	248	617	2,745	77.5	5,316
1962	1,797	340	573	2,710	78.9	4,770
1963	1,779	347	590	2,716	78.3	4,076
1964	1,888	305	829	3,022	72.6	4,032

[1] American Association of Petroleum Geologists, annual June issues of Bulletin; success percentage computed here. Excludes wells drilled for gas storage or secondary-recovery operations.
[2] Oil and Gas Journal, annual forecast-review issues.

TABLE V.—DRILLING ACTIVITY IN OKLAHOMA, 1964

	1964					1963	1965
	CRUDE	GAS	DRY	SERVICE	TOTAL	TOTAL	FORECAST
All wells							
Number of completions	2,256	464	1,286	510	4,516	4,492	4,735
Footage	9,307,244	2,915,005	5,351,219	891,625	18,465,093	17,360,099	19,529,000
Average footage	4,126	6,282	4,161	1,748	4,089	3,865	
Exploration wells							
Number of completions	108	52	324		484	416	575
Percentage of completions	22.3	10.7	67.0		100		
Footage	748,066	382,983	1,756,919		2,887,968	2,240,735	
Average footage	6,927	7,365	5,423		5,967	5,386	
Development wells							
Number of completions	2,148	412	962	510	4,032	4,076	4,160
Footage	8,559,178	2,532,022	3,594,300	891,625	15,577,125	15,119,364	

Source: Oil and Gas Journal, annual forecast and review issue, vol. 63, no. 4, January 25, 1965.

TABLE VI.—HYDROCARBON PRODUCTION IN OKLAHOMA, 1963-1964

	END OF 1963	END OF 1964
Crude oil and lease condensate		
Total annual production (1,000 bbls)[1]	201,962	200,515
Value ($1,000)[1]	587,709	581,494
Cumulative production, 1891-year (1,000 bbls)[1]	8,824,271	9,024,786[4]
Daily production (bbls)[3]	549,370	556,000
Total number of producing wells[3]	81,952	83,068
Daily average per well (bbls)[3]	6.7	6.7
Oil wells on artificial lift (estimated)[2]	77,686	76,602
Natural gas		
Total annual marketed production (MMCF)[1]	1,233,883	1,360,000
Value ($1,000)[1]	160,405	179,500
Total number of gas and gas condensate wells[2]	6,639	6,813
Natural-gas liquids		
Total annual marketed production (1,000 gals)[1]	1,366,361	1,424,700
Value ($1,000)[1]	64,112	68,300

[1] Item for 1963 is U. S. Bureau of Mines final figure. Item for 1964 is U. S. Bureau of Mines preliminary figure: U. S. Bureau of Mines, Mineral Industry Surveys Area Report IV-183; **also in** Okla. Geology Notes, vol. 25, p. 32.

[2] World Oil, 1965 forecast and review issue, vol. 160, no. 3, February 15, 1965.

[3] Oil and Gas Journal, annual forecast and review issue, vol. 63, no. 4, January 25, 1965.

[4] Figure differs from that shown in column 2 of table VIII (9,050,525 Mbbls) because it is based upon a cumulative-production figure through 1958 of 7,836,373 Mbbls (Amer. Petroleum Inst., 1959, Petroleum facts and figures, Centennial edition, p. 41).

TABLE VII.—HELIUM RECOVERED FROM NATURAL GAS IN OKLAHOMA, 1959-1964

YEAR	VOLUME (MCF)	VALUE ($1,000)
1959	98,749	1,619
1960	289,069	4,691
1961	313,244	5,872
1962	284,214	9,917
1963	237,201	8,302
1964	230,886	8,081
Total	1,453,363	38,482

TABLE VIII.—CUMULATIVE (THROUGH 1954) AND YEARLY (1955-1964) MARKETED PRODUCTION AND VALUE OF PETROLEUM, NATURAL GAS, NATURAL GASOLINE, AND LIQUEFIED PETROLEUM GAS IN OKLAHOMA[1]

YEAR	CRUDE PETROLEUM		NATURAL GAS		NATURAL GASOLINE AND CYCLE PRODUCTS		LIQUEFIED PETROLEUM GAS	
	VOLUME (1,000 BBLS)	VALUE ($1,000)	VOLUME (MMCF)	VALUE ($1,000)	VOLUME (1,000 GALS)	VALUE ($1,000)	VOLUME (1,000 GALS)	VALUE ($1,000)
Through 1954[2]	7,027,193	$10,831,440	12,363,256	$1,333,033	13,915,790	$861,959	3,161,044	$105,800
1955	202,817	563,830	614,976	45,508	504,692	28,770	512,320	14,297
1956	215,862	600,096	678,603	54,288	489,963	26,543	579,101	23,427
1957	214,661	650,423	719,794	59,743	460,644	25,329	587,140	21,824
1958	200,699	594,069	696,504	70,347	440,798	26,029	657,114	25,822
1959	198,090	578,423	811,508	81,151	448,353	29,443	675,869	27,070
1960	192,913	563,306	824,266	98,088	531,995	33,074	762,258	32,409
1961	193,081	561,866	892,697	108,016	521,237	33,358	817,082	30,141
1962	202,732	591,977	1,060,717	135,772	552,795	35,764	838,903	25,223
1963	201,962	587,709	1,233,883	160,405	555,467	35,131	810,894	28,981
1964	200,515	581,494	1,360,000	179,500	575,800	36,900	848,900	31,400
	9,050,525	$16,704,633	21,256,204	$2,325,851	18,997,534	$1,172,300	10,250,625	$366,394

[1] Final figures by U. S. Bureau of Mines for all years except 1964.
[2] Crude petroleum, 1891-1954; natural gas, 1902-1954; natural gasoline, 1911-1954; liquefied petroleum, gas, 1941-1954. From: Oklahoma Geological Survey, 1958, Fifty years' progress, Semi-centennial report, p. 28-29, table 1.

TABLE IX.—BASEMENT TESTS DRILLED IN OKLAHOMA IN 1964

COUNTY	LOCATION SEC.	T.	R.	WELL NAME	ELEVATION DATUM (FT)	TOP ARBUCKLE (FT)	TOP BASEMENT (FT)	LOCATION OF SAMPLES
Pontotoc	7 C	4N SW	4E SW	Tidewater 1 W. Wood	1112	2846	5528	OGS, Shawnee: 500-6060
Pottawatomie	19 SE	7N SW	5E SE	Hembree C-3 Hembree	927	4915	7755	OGS: 4102-7781
Wagoner	5 SW	16N NE	16E NW	Emrich & Austin 1 Carter	573	1590	3092	OGS: 200-3098
Tulsa	5 NW	19N NE	12E SW	A. J. Geiger 4 Hayden	675E	2032	2748	None located
Osage	10 NE	22N SE	8E SW	Jernigan & Morgan 1 Osage (Degen)	931	2579	2850[1]	Shawnee: 1000-2606
Osage	13 SE	22N NE	8E NW	F. DeMier 8 Osage (Shannon)	840	2543	2664	None located
Osage	13 SW	22N SE	8E NW	F. DeMier 9 Osage (Shannon)	828	2666	3315	None located
Osage	8 SW	23N NE	8E SW	Pure & Sinclair 196 Osage (Hominy)	1076	2776	3001	Shawnee: 53-3010
Osage	8	23N NE	8E NW	Pure & Sinclair WS-1 Osage (Hominy)	938	2656	3055	Shawnee: 80-3005
Osage	20 C	23N SW	8E SE	Producers Oil 16 Osage	1040	2770	3064[1]	None located
Osage	29 SE	23N NE	9E SE	Appleton Oil 1B Osage	803	2484	3049[1]	None located
Osage	24 NE	24N SW	9E NW	Sunray DX S-1 NW 24-24-9	971	2534	3276	None located
Osage	23 SW	24N NW	10E SE	Sunray DX S-1 Osage	868	2172	2613	None located
Osage	9 N/2	24N N/2	12E	Varn Petroleum 1-WS Osage	920	2052	2804	None located

Rogers	14 24N 18E NE NW NW	Sunray DX 1 O. Magness	857	888	2194+	Near basement. Bottom sample at OGS.
Osage	22 27N 8E C S/2 N/2 SW	Appleton Oil 1 Osage (Hickory Ck.)	1058	2696	3626	None located
Bryan	7 7S 10E C NW SE	California 1 E. Williams Unit	645	4825	7184	Ardmore: 1430-8400
Garvin	15 1N 3W C NW NW	Mobil 13 Mauldin B	990	1886	4656	OGS: cores Ardmore: 10-4980
Comanche	17 2N 10W SE SE SE SE	G & G 3 School Land	1233	absent	968	None located
Comanche	21 2N 10W NW NW SW NE	D. L. Glenn 3 Fullerton	1172	absent	920	None located
Comanche	30 2N 10W SE NW SE NE	Darrell Smith 5 Fuqua	1225E	absent	805	None located
Comanche	4 3N 11W C NW SE SW	Humble 1 Conn Heirs	1305	absent	822	Ardmore: 90-1080
Comanche	5 3N 11W SE NE	Humble 1 J. Glover	1217	absent	1416	Ardmore: 0-1590
Jackson	2 4N 19W SE SE SE	D & J Prod. 1 Warren (Willingham)	?	absent	?	OGS: 0-2580
Greer	5 7N 24W C SE NW NW	O. P. Russell 1 Falkner	1893	absent	2000	None located
Beckham	7 8N 22W C NE NW SE	Cecil Sims 1 Smith	1785	absent	1994	None located
Beckham	18 8N 23W NW SE NW	Bolin Oil 1 N. J. Smith	1936	absent	2116	None located
Noble	15 23N 2W NW SE	Okla. Nat. Gas 1 Hardrow	968	4084	5462	OGS, Shawnee: 1810-5505

[1] No electric log available.

Names of Oklahoma Coal Beds

Carl C. Branson

Coal beds are in most cases named informally by miners or operators, with different names for the same coal bed at separate localities. Geologists select and place in print the most used or the best established name, or the one which seems most applicable to each coal bed. Many of the names are descriptive (One-foot, Red, Peacock, High-splint, Pilot) or are for local mining areas (Blocker, Lightning Creek). An unsigned preliminary list was published by me in *The Hopper* in 1954.

The code of stratigraphic nomenclature rules that coal names are informal, and for this reason the word "coal," as in Secor coal, is not to be capitalized. Reasons for the rule are convincing. In older coal-mining areas, such as Pennsylvania, West Virginia, and Kentucky, names duplicate each other (Washington, Little Washington, Washington A), or are the same as names of rock-stratigraphic units, and in some areas numbers are used for coals. Valid and unduplicated geographic names are being applied in some areas, as they should be if possible. A coal bed is a rock unit; many are continuous over wide areas and serve as stratigraphic markers, and these deserve to be recognized under rock-stratigraphic names. As the most distinctive unit of a cyclothem, it is desirable that the coal bed have a usable name.

Oklahoma coals, with a few exceptions, have names of geographic origin which fulfill that requirement of the code. Many have names used for rock-stratigraphic units.

Names of coals which conflict with established names of rock-stratigraphic units are:

Bluejacket coal: Bluejacket Sandstone, McCoy, 1921.

Cavanal coal: Name used for group with McAlester and Savanna Formations (as Cavaniol) by Drake, 1898. Name declared available (Okla. Geology Notes, vol. 17, p. 100).

Dawson coal: Name used for an arkose in Colorado, Richardson, 1912.

Fleming coal: Name given to Fleming Group (Neogene) of Texas and Louisiana by Kennedy, 1892.

Hartshorne coal: Name long established for Hartshorne Sandstone, Taff, 1899.

Lexington coal: Name in use since 1898 for a Middle Ordovician sequence in Kentucky (M. R. Campbell), and has been used for a Pennsylvanian group of Missouri by Broadhead, 1873, and for an Ordovician limestone of Virginia, J. L. Campbell, 1879.

McAlester coal: Established name of McAlester Formation which includes the coals, Taff, 1899.

Pawpaw coal: Name in use for Pawpaw Member of Denison Formation of Texas, Hill, 1894.

Ralston coal: Prior use for a Pennsylvanian-Permian sequence in

Oklahoma by Gould and others, 1910, and for an Eocene unit in Wyoming by Sinclair and Granger, 1912.

Rowe coal: Name used for a Cambrian? schist of Massachusetts and Vermont, Emerson, 1892. Missouri Geological Survey uses Rowe Formation for unit containing the coal.

Sequoyah coal: Name applied by Campbell in 1897 to a Pennsylvanian formation of West Virginia.

Thayer coal: Name given to a shale in Kansas City Formation of Kansas by Haworth, 1895.

The Missouri Geological Survey uses formations consisting of sequences from the top of a coal bed to the top of the next coal bed. These formation names include Riverton, Rowe, Drywood, Bluejacket, Tebo, Scammon, Mineral, Robinson Branch, Fleming, Croweburg, Bevier, and Mulky, each the name of a coal.

Establishment of unique rock-stratigraphic names of geographic origin for coal beds would require an almost completely new set of names. Such a new set would be difficult to find and would not be readily accepted.

Names not now used by geologists are marked by an asterisk.

*Adams coal. McAlester Formation. Krebs Group.
Chance, 1890, Amer. Inst. Mining Engineers, Trans., vol. 18, pl. 2.
Name from Adams farm, sec. 30, T. 5 N., R. 17 E., Pittsburg County.
Equal to McAlester coal.

*Ardmore coal. Hoxbar Group. Missouri Series.
Taff, 1904, Dept. Interior, Circ. 5, p. 360.
Coal at base of Daube Limestone. Mined by shaft and strip pit at one locality. Has also been Daube coal.

*Atoka coal.
Taff, 1902, U. S. Geol. Survey, 22d Ann. Rept., pt. 3, p. 379.
Named for city of Atoka, Atoka County.
Equal to Hartshorne coal.

Baldwin coal. Woolsey Shale. Morrow Group.
Croneis, 1930, Ark. Geol. Survey, Bull. 3, p. 82.
Source of name not given.
One probable locality in Oklahoma, Bayou Manard, NE¼ sec. 20, T. 15 N., R. 20 E., Cherokee County.
Not mined.

Bevier coal. Senora Formation. Cabaniss Group.
McGee, 1888, St. Louis Acad. Science, Trans., vol. 5, p. 331.
Name from town of Bevier, Macon County, Missouri.
Occurs in two benches; upper bench is now called Bevier, lower bench Wheeler.
Thin and not workable in Craig County.
Second coal above Verdigris Limestone.

*Blocker coal. Boggy Formation. Krebs Group.
Shannon, 1926, Okla. Geol. Survey, Bull. 4, p. 36.
Named for town of Blocker, sec. 24, T. 7 N., R. 16 E., Pittsburg County.

Equal to Secor coal. Called Jones Creek coal in McCurtain and Massey mines.

Bluejacket coal. Boggy Formation. Krebs Group.

Searight and others, 1953, Amer. Assoc. Petroleum Geologists, Bull., vol. 37, p. 2748.

Name from town of Bluejacket, Craig County.

Coal bed above Bluejacket Sandstone. Mined on Timbered Hill and near Estella, Craig County, and at one locality in Mayes County.

*Bonanza coal. Hartshorne Formation. Krebs Group.

Taff, 1900, U. S. Geol. Survey, 21st Ann. Rept., pt. 2, p. 302.

Named for town of Bonanza, Sebastian County, Arkansas.

Probably equal to Hartshorne coal. Once mined near Pocola.

*Broken Arrow coal.

Taff, 1905, U. S. Geol. Survey, Bull. 260, p. 394.

Named for city of Broken Arrow, Tulsa County.

Equal to Croweburg coal, the preferred name.

Cavanal coal. Savanna Formation. Krebs Group.

Taff, 1900, U. S. Geol. Survey, 21st Ann. Rept., pt. 2., p. 292.

Named for Cavanal Station, Le Flore County.

Mined in Le Flore County, Poteau district.

Cedar Bluff coal. Coffeyville Formation. Missouri Series.

Jewett, 1932, Kans. Geol. Soc., 6th Ann. Field Conference, p. 107.

Named for Cedar Bluff, escarpment in hill 3 miles northwest of Coffeyville, Labette County, Kansas.

Coal thin in Osage County.

Second coal bed below Hogshooter Limestone.

*Cherokee coal.

Apparently named from Cherokee lands of northeastern Oklahoma.

Name applied to several coals, including Croweburg and Weir-Pittsburg.

*Coalgate coal.

Named for town of Coalgate, Coal County.

Same as McAlester (Lehigh) coal.

Commonly called Coalgate-Lehigh coal.

*Crowder coal.

Named for town of Crowder, Pittsburg County.

Equal to Secor coal, the preferred name.

Croweburg coal. Senora Formation. Cabaniss Group.

Pierce and Courtier, 1937, Kans. Geol. Survey, Bull. 24, p. 74.

Named for town of Croweburg, Crawford County, Kansas.

Has been called Henryetta, Broken Arrow.

Mined at Henryetta, Okmulgee, Catoosa, and Sequoyah.

*Daube coal.

Named for Mr. Daube of Daube, Westheimer and Zuckermann Company, which operated the mine.

Coal at base of Daube Limestone.

Normally called Ardmore coal.

Dawson coal. Seminole Formation. Missouri Series.

Taff, 1905, U. S. Geol. Survey, Bull. 260, p. 396.

Named for town of Dawson, now in Tulsa.
Once dug commercially in Tulsa County, and at a few places in Nowata and Creek Counties.

Drywood coal. Savanna Formation. Krebs Group.
Searight and others, 1953, Amer. Assoc. Petroleum Geologists, Bull., vol. 37, p. 2748.
Named for Dry Wood Creek, Vernon County, Missouri.
Mined in Oklahoma in Craig County, at one place in Mayes County; occurs in Rogers County.

Elmo coal. Wabaunsee Group. Virgil Series.
Original reference not found (see Whitla, 1940, Kans., State Geol. Survey, Bull. 32, p. 23).
Name probably from town of Elmo, Nodaway County, Missouri.
Occurs in Osage County.

Eram coal. Senora Formation. Cabaniss Group.
Trumbull, 1957, U. S. Geol. Survey, Bull. 1042, p. 352.
Named for village of Eram, Okmulgee County.
Once mined in small pits.

Fleming coal. Senora Formation. Cabaniss Group.
Pierce and Courtier, 1937, Kans. Geol. Survey, Bull. 24, p. 73.
Named for town of Fleming, Crawford County, Kansas.
Occurs in Craig County, but thin and not workable.

*Fort Scott coal.
Shannon, 1926, Okla. Geol. Survey, Bull. 4, p. 41, may be first published use.
Name from Fort Scott, Kansas, or from Fort Scott Limestone.
Used for Iron Post coal in Oklahoma, for Mulky coal in Kansas.

*Grady coal.
Chance, 1890, Amer. Inst. Mining Engineers, Trans., vol. 18, p. 653, pls. 1, 2.
Chance divided into Lower, Middle, and Upper Grady.
Equal to Hartshorne coal.

*Hackett coal.
Taff, reference not located.
Named for Hackett district, Sebastian County, Arkansas.
Equal to Hartshorne coal. Name little used in Oklahoma.

Hartshorne coal. Hartshorne Formation. Krebs Group.
Taff, 1899, U. S. Geol. Survey, 19th Ann. Rept., pt. 3, p. 435.
Named for town of Hartshorne, Pittsburg County.
Lower Hartshorne coal most important; mined in Pittsburg, Latimer, Haskell, and Le Flore Counties.
Upper Hartshorne coal once mined in Coal, Pittsburg, Latimer, Muskogee, Haskell, Le Flore, Sequoyah, and Cherokee Counties.
Called Hartshorne coal where beds are mined as one and are stratigraphically near one another.

*Henryetta coal.
Taff, 1905, U. S. Geol. Survey, Bull. 260, p. 295.
Name from town of Henryetta, Okmulgee County.
Same as Croweburg coal, the preferred name.

Iron Post coal. Senora Formation. Cabaniss Group.

Howe, 1951, Amer. Assoc. Petroleum Geologists, Bull., vol. 35, p. 2092.

Named for Iron Post School, Craig County.

Has been called Fort Scott coal and misidentified as Mulky coal.

Mined in Craig County and once mined in Rogers County.

*Jones Creek coal.

Taff, 1904, U. S. Dept. Interior, Circ. 4, p. 13.

Named for Jones Creek district, T. 7 N., R. 16 E., Pittsburg County.

Equal to Secor coal, the preferred name.

*Lehigh coal.

Taff, 1899, U. S. Geol. Survey, 19th Ann. Rept., pt. 3, p. 454.

Named for town of Lehigh, Coal County.

Equal to McAlester coal.

Lexington coal. Labette Formation. Marmaton Group.

Broadhead, 1872, Mo. Geol. Survey, p. 46.

Named for town of Lexington, Missouri.

Thin and not workable in Craig and Rogers Counties.

*Lightning Creek coal.

Named for Lightning Creek, Craig County.

Equal to Iron Post coal.

*Little Cabin coal.

Pierce and Courtier, 1935, Kans. Geol. Survey, map.

Equal to Riverton coal.

Lorton coal. Wabaunsee Group. Virgil Series.

Original reference not found (see Schoewe, 1946, Kans., State Geol. Survey, Bull. 63, p. 49).

Named in all probability for Lorton, a village in Otoe County, Nebraska.

Occurs in Payne County below the Greyhorse Limestone.

*Lower Boggy coal.

Newell, 1937, Okla. Geol. Survey, Bull. 57, p. 53.

Coal in lower part of Boggy Formation.

Probably Rowe coal.

*Massey coal.

Shannon and others, 1926, Okla. Geol. Survey, Bull. 4, p. 36.

Named for town of Massey, T. 7 N., R. 16 E., Pittsburg County.

Equal to Secor coal.

*Mayberry coal.

Chance, 1890, Amer. Inst. Mining Engineers, Trans., vol. 18, p. 658, pl. 1.

Named for Mayberry mine on Cavanal Mountain, Le Flore County.

Equal to Secor coal (upper Witteville).

McAlester coal. McAlester Formation. Krebs Group.

Chance, 1890, Amer. Inst. Mining Engineers, Trans., vol. 18, p. 656, 658, pl. 1.

Named for city of McAlester, Pittsburg County.

Mined in Pittsburg, Latimer, and Coal Counties.

*McCurtain coal.
First printed use not determined.
Named for town of McCurtain, Haskell County.
Equal to Hartshorne coal.

Mineral coal. Senora Formation. Cabaniss Group.
Pierce and Courtier, 1935, Kans. Geol. Survey, Bull. 24, p. 69.
Named for town of Mineral, Cherokee County, Kansas.
Mined in northern Craig County.

Morris coal. Senora Formation. Cabaniss Group.
Dunham and Trumbull, 1955, U. S. Geol. Survey, Bull. 1015, p. 197.
Named for town of Morris, Okmulgee County.
Once mined near Morris.

Neutral coal. McAlester Formation. Krebs Group.
Searight and others, 1953, Amer. Assoc. Petroleum Geologists, Bull., vol. 37, p. 2748.
Not found in Oklahoma, but Howe suggested that Oklahoma Rowe coal is Neutral coal.

Nodaway coal. Wabaunsee Group. Virgil Series.
Broadhead, 1873, Mo. Geol. Survey, p. 398.
Name from that of Nodaway River, Nodaway County, Missouri.
Thin bed in Osage County, Oklahoma; mined in Missouri and Kansas.
Below Bird Creek Limestone.

*Norman coal.
Chance, 1890, Amer. Inst. Mining Engineers, Trans., vol. 18, p. 658, pl. 1.
Coal bed not identified; name not used since 1890.

*Panama coal. Hartshorne Formation. Krebs Group.
Taff, 1900, U. S. Geol. Survey, 21st Ann. Rept., pt. 2, p. 302.
Named for town of Panama, Le Flore County.

*Pawpaw coal. Senora Formation. Cabaniss Group. Lohman, 1952, unpublished Master of Science thesis, p. 29.
Name is that of Pawpaw Creek, Craig County.
Once stripped near Catale, and used for coal stripped west of Estella.

*Peacock coal.
Term for coal with pleochroic colors on joint faces.

*Pilot coal.
Name for a noncommercial coal which overlies and shows position of commercial coal. Used for Tebo coal in Kansas.
Lies a few feet above Weir-Pittsburg coal.

*Pittsburg coal.
Shannon and others, 1926, Okla. Geol. Survey, Bull. 4, p. 24.
Named for town of Pittsburg, Pittsburg County.
Easily confused with Pittsburg, Kansas, and Pittsburgh, Pennsylvania.
Equal to McAlester coal.

*Quinton coal.
Named for town of Quinton, Haskell County.

Equal to Secor coal.

Ralston coal. Wood Siding Formation. Virgil Series.
Greig, 1959, Okla. Geol. Survey, Bull. 83, p. 67.
Named for town of Ralston, Pawnee County.
Coal bed below Brownville Limestone in Pony Creek Shale Member.
Once dug in Pawnee County, occurs also in Osage and Payne Counties.

*Red coal.
Term for coal reddened on joint planes by iron oxide deposits.

Red Branch coal. Woodbine Formation. Upper Cretaceous.
Bergquist, 1949, U. S. Geol. Survey, Oil and Gas Inv., Prelim. Map 98.
Coal in Red Branch Member of Woodbine Formation.
Member named for Red Branch community, Grayson County, Texas.
Thin and not worked in Bryan County.

Riverton coal. Hartshorne Formation. Krebs Group.
Pierce and Courtier, 1937, Kans. Geol. Survey, Bull. 24, p. 62.
Named for town of Riverton, Cherokee County, Kansas.
Thin in Craig and Ottawa Counties; not mined.

Robinson Branch coal. Senora Formation. Cabaniss Group.
Searight and others, 1953, Amer. Assoc. Petroleum Geologists, Bull., vol. 37, p. 2748.
Named for Robinson Branch, Vernon County, Missouri.
No coal in Oklahoma.

Rowe coal. Savanna Formation. Krebs Group.
Pierce and Courtier, 1937, Kans. Geol. Survey, Bull. 24, p. 65.
Named for Rowe School, NW cor. sec. 34, T. 30 S., R. 25 E., Cherokee County, Kansas.
Once dug in small pits in Craig, Mayes, Rogers, Wagoner, Muskogee, and McIntosh Counties.

Scammon coal. Senora Formation. Cabaniss Group.
Named for town of Scammon, Cherokee County, Kansas.
No workable deposit in Oklahoma.

Secor coal.
Chance, 1890, Amer. Inst. Mining Engineers, Trans., vol. 18, p. 658, 660, pl. 1.
Origin of name not determined, but M. C. Oakes states that Secor family lived in northern Pittsburg County.
Strip mined in Pittsburg, Haskell, McIntosh, and Wagoner Counties.

Sequoyah coal. Senora Formation. Cabaniss Group.
Named for town of Sequoyah, Rogers County.
Coal bed below Croweburg coal. Name is also locally used for Croweburg coal near town of Sequoyah.

Stigler coal. McAlester Formation. Krebs Group.
Taff, 1904, Dept. Interior, Circ. 2 (U. S. 61st Cong., 2d sess., Senate Document 390, p. 188).
Named for town of Stigler, Haskell County.

Tebo coal. Senora Formation. Cabaniss Group.
Named for Tebo Creek, Henry County, Missouri.
Lies below Tiawah Limestone. Thin and unworkable in Craig, Rogers, and Wagoner Counties.

Thayer coal. Chanute Shale. Missouri Series.
Haworth, 1895, Kans., Univ., Quart., vol. 3, p. 276.
Named for town of Thayer, T. 29 S., R. 18 E., Neosho County, Kansas.
Thin and unworkable in Nowata and Washington Counties.

Weir-Pittsburg coal. Senora Formation. Cabaniss Group.
Named for coal towns of Weir and Pittsburg, Kansas.
Strip mined in north-central Craig County.

*Welch coal.
Named for town of Welch, Craig County.
Believed to be Weir-Pittsburg bed, although Mineral coal was once widely mined northwest of Welch.

*Wheeler coal.
Named for a Missouri area; is lower bench of the Bevier.
No coal in Oklahoma.

*Witteville coal.
Named for town of Witteville, Le Flore County.
Upper Witteville coal is equal to Secor coal, the preferred name.
Lower Witteville coal was locally mined.

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Late Wisconsinan Date for the Bar M Local Fauna

Arthur J. Myers

The Bar M local fauna was described by Taylor and Hibbard (1955) from the Pleistocene deposits in NW¼ sec. 13, T. 28 N., R. 22 W. (locality 1) and SE cor. sec. 14, T. 26 N., R. 23 W. (locality 2), Harper County, Oklahoma. The deposits consist of gray silt deposited in lake basins during some part of the late Pleistocene. Several such deposits were mapped by Myers (1959).

At both localities the silt contains abundant remains of mollusks, and at locality 1 in the darker silt laid down near an old lake shore a few scutes of an extinct armadillo *(Dasypus bellus)* were found in association with the mollusk shells.

The Bar M local fauna consists of at least 40 species of mollusks. Only two species are common to the black and gray silt at locality 1, and most of the mollusks in the gray silt are fresh-water species, whereas those of the black silt are land snails. Ten species are common to localities 1 and 2. Taylor and Hibbard stated that this distribution suggests a difference in age and/or habitat between the sites or that it could be caused by a sampling error. However, they believed that the two faunas of locality 1 constitute a single assemblage and that both localities are of about the same age.

Of the 40 species, 11 live today in the northern part of the Great Plains, from Nebraska to North Dakota.

Taylor and Hibbard (1955, p. 10-13) compared the Bar M mollusks with those of the Jones and Jinglebob faunas of southwestern Kansas and of the Berends fauna of Beaver County, Oklahoma. They tentatively correlated the Bar M fauna with the Berends fauna and considered both to be probably Illionian in age.

Slaughter (1961) stated that the *Dasypus novemcinctus* (the modern nine-banded armadillo) was unknown in the United States prior to the report of Audubon and Bachman It was first reported only in extreme southern Texas, but since then it has extended its range northwestward to the escarpment of the High Plains, northward to southern Kansas, and eastward to areas east of the Mississippi River. The armadillo requires a vast quantity of insects for food, and the insects upon which it feeds (mainly ants, termites, and beetles) require rotting wood or a deep moist soil for their development. Therefore the limiting range is along the 18- to 20-inch rainfall belt. The armadillo also requires a mild climate, as a single severe winter could kill whole populations.

D. bellus was three times as large as *D. novemcinctus*, and Slaughter believed that it would therefore have needed a larger quantity of a similar diet and that it would also have needed a mild climate. Therefore, if Taylor and Hibbard were correct with an Illinoian dating of the Bar M local fauna, during Sangamon time the armadillo should have extended its range northward into Kansas. Because the armadillo's carapace is better preserved than are the remains of most other animals and because the Sangamon fauna of Kansas is well known through extensive collection by washing, which would exclude chance sampling, Taylor and Hibbard (1955, p. 9) believed that the Bar M local fauna must be Wisconsinan in age.

To confirm the paleontological age determination, Hibbard (written communication) secured a carbon-14 dating, which was done in 1964 by Ellis E. Bray of the Socony Mobil Oil Company on mollusk shells from locality 1. The sample was measured by the methane-proportional-counter method reported by Burke and Meinschein (1955). Shell samples were mechanically cleaned and washed with water. Where necessary, cold dilute hydrochloric acid was used to remove the powdery exterior. Bray determined a date of 21,360±1,250 B. P. In a written communication he stated:

> The error given includes contributions from the following sources:
>
> (1) Standard statistical counting error.
>
> (2) Background variation. This is taken as equal to the rms deviation from the mean of background determinations made during a period of time beginning well before and ending well after the counting of the sample.
>
> (3) Variation in counting rate of the modern standard. This is determined in the same way as (2).

Rubin, Likens, and Berry (1963, p. 88) concluded about the validity of radiocarbon dates for snail shells:

> (1) Tracer measurements of the incorporation of inorganic carbon in the shells of snails indicate that an uptake of 10-12 percent is possible in an extremely favorable enviornment. This provides an estimate of the maximum "dead" carbon that a snail can use in making its shell. The remainder of the carbon in the shell carbonate must come from food or the atmosphere, and the resulting C^{14}/C^{12} ratio will be essentially the same as in those sources.
>
> (2) Uncertainties in radiocarbon dates from snail shells can be of the order of one thousand years or somewhat more, depending on the food source, and are of the same range as the analytical error in older age samples. When used conservatively, they can be helpful in dating geologic deposits.

Taking into account the error in the method and the validity of radiocarbon dating of snail shells, the date of 21,360±1,250 B. P. would give a late Wisconsinan age to the snails and to the associated armadillo scutes and lake deposits.

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Slaughter, B. H., 1961, The significance of **Dasypus bellus** (Simpson) on Pleistocene local faunas: Texas Jour. Science, vol. 13, p. 311-315.
Taylor, D. W., and **Hibbard, C. W.,** 1955, A new Pleistocene fauna from Harper County, Oklahoma: Okla. Geol. Survey, Circ. 37, 23 p.

Status of Paleontological Treatises

Carl C. Branson

The *Treatise on Invertebrate Paleontology,* edited by R. C. Moore and published by the Geological Society of America and the University of Kansas Press, is planned to consist of 24 volumes of which 13 have appeared to date. The French *Traité de Paléontologie* is to have seven volumes of which six and part of another have been issued. The German *Handbuch der Palaeozoologie* has but a few issues, of which the Wenz Gastropoda volume is the one large contribution.

The last volume of the fifteen-volume Russian *Osnovy Paleontologii* has just been received. The Russian treatise includes descriptions of vertebrates and plants. The last volume issued is eleventh in the listing and includes primitive chordates and fishes. The volume was written by Obruchev, Novenkaya, Glückman, Vorob'eva, Kazancheva, Daniltschenko, Berg, and Sergeeva. It consists of 533 pages, 673 text-figures, and 45 excellent plates. Conodonts are included as Incertae sedis in the last section.

Unlike many of the previous volumes no nomina nuda appear. New taxa proposed are:

Diplorhina (Pteraspidomorphi)

Thelodonti

Palaeodontidae Obruchev, new family, for *Palaeodus* Rohon and *Archodus* Rohon, p. 43. Lower Ordovician.

Heterostraci

Turiniidae Obruchev, new name, p. 43, for Cephalopteridae Powrie, 1870, named from homonym *Cephalopterus* (equal *Turinia* Traquair, 1896). Lower Devonian.

Steinaspis Obruchev, new genus, p. 58. Type species by monotypy and original designation *S. miroshnikovi* Obruchev, new species, p. 58, pl. 2, fig. 2. Downtonian.

Bothriaspis Obruchev, new genus, p. 60. Type species *Ctenaspis kiaeri* Zych, 1931. Lower Devonian.

Putoranaspis Obruchev, new genus, p. 60. Type species *P. prima* Obruchev, new species, p. 60, text-fig. 23; *P. dentata* Obruchev, pl. 3, figs. 1, 2, appears to be *P. prima.* Lower Devonian.

Aphataspis Obruchev, new genus, p. 61. Type species *A. kiaeri* Obruchev, new species, p. 61, text-fig. 24, pl. 3, figs, 4, 5. Lower Devonian.

Yukonaspis Obruchev, new genus, p. 63. Type species *Traquairaspis angusta* Denison, 1963. Upper Silurian of Yukon Territory, Canada.

Grumantaspis Obruchev, new genus, p. 68. Type species *Pteraspis*? *lyktensis* N. Heintz, 1960. Lower Devonian of Spitsbergen.

Pelurgaspis Obruchev, new genus, p. 78. Type species *P. macrorhyncha* Obruchev, new species, p. 78, text-fig. 64, pl. 4, fig. 2. Lower Devonian.

Olbiaspididae Obruchev, new family, p. 78.

Olbiaspis Obruchev, new genus, p. 78, replaces *Menneraspis* Obruchev, 1958, nude name. Type species *O. coalescens* Obruchev, new species, p. 78, text-fig. 65, pl. 4, fig. 1. Lower Devonian.

Siberiaspis Obruchev, new genus, p. 78. Type species *S. plana* Obruchev, new species, p. 78, text-fig. 66, pl. 5, fig. 4. Lower Devonian.

Angaraspis Obruchev, new genus, p. 79. Type species *A. urvantzevi* Obruchev, new species, p. 79, text-fig. 67, pl. 5, fig. 2. Lower Devonian.

MONORHINA (CEPHALASPIDOMORPHI)

Osteostraci

Tannuaspidae Obruchev, new family, p. 98.

PLACODERMI

Arthrodira

Radotinidae Obruchev, new family, p. 132.

Rhenonema Obruchev, new genus, p. 142. Type species *Dinichthys eifelensis* Kayser, 1880. Middle Devonian.

Groenlandaspididae Obruchev, new family, p. 143.

Euleptaspididae Obruchev, new family, p. 144.

Clarkeosteus Obruchev, new genus, p. 145. Type species *Coccosteus*? *halmodeus* Clarke, 1894. Middle Devonian of New York.

Eastmanosteus Obruchev, new genus, p. 146. Type species *Dinichthys pustulosus* Eastman, 1897. Upper Devonian of Ohio.

Hussakofiidae Obruchev, new family, p. 148.

Erromenosteidae Obruchev, new family, p. 150.

Wijdeaspis Obruchev, new genus, p. 156. Type species *Acanthaspis arctica* Heintz, 1929. Middle Devonian of Spitsbergen.

CHONDRICHTHYES

Elasmobranchii

Polyacrodontidae Glückman, new family, p. 212.

Palaeohypotodus Glückman, new genus, p. 231. Type species *Odontaspis rutoti* Winkler, 1874. Paleogene of Belgium.

Holocephali

Syntomodus Obruchev, new genus, p. 252. Type species *S. abbreviatus* Obruchev, new species, p. 252, pl. 4, fig. 3. Upper Permian.

Pseudodontichthyidae Obruchev, new family, p. 255.
Metaxyacanthus Obruchev, new genus, p. 256. Type species *Dactylodus rossicus* Inostranzeff, 1888.

OSTEICHTHYES

Sarcopterygii

Grossipterus Obruchev, new genus, p. 308. Type species *Dipterus*? *crassus* Gross, 1933. Upper Devonian, Baltic area.

Actinopterygii

Tompoichthys Obruchev, new genus, p. 361. Type species *T. abramovi* Obruchev, new species, p. 361, pl. 2, fig. 1. Lower Triassic.

One unavoidable feature is the sanction of replacement names given for homonyms by the notorious parasite Embrik Strand. Some of these are *Homalaspidella* (p. 58), *Dinaspidella* (p. 59), *Cryptaspidisca* (p. 60), *Lataspis* (p. 138), *Heterogaspis* (p. 140).

The inadvisability of establishing new taxa in the necessarily brief form possible in a synthesis is illustrated by *Syntomodus* Obruchev, new genus (p. 252). The genus is undescribed and is placed in the Helicoprionidae. The generic concept rests solely upon the type species, *S. abbreviatus* Obruchev, new species. The total description, translated by M. K. Elias, reads:

> Upper Permian. River Echii, basin of River Yana, Jacutia. Small forms, symphysial arch composed of short teeth, which have erect serrate cutting crowns and short indented alar flanges below (pl. 4, fig. 3). The only species and specimen of the genus.

The figure shows a fragment which appears to be from an unidentifiable organism.

The fifteen-volume work was a massive undertaking and it was prepared in but a few years. The size of the task was great and the contribution huge. The quality is but fair, but the series is useful in illuminating the interests of Russian paleontologists.

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